People Caring About Water

A to Z
Aerobic Treatment Units

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Mystic Marriott Hotel
Groton, Connecticut

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NOWRA
National Onsite Wastewater Recycling Association

Objectives

- To describe aerobic treatment options that use aerobic digestion to lower organic compounds found in domestic wastewater
- To describe situations where these systems may be useful

Traditional Treatment

- Septic tank
  - Anaerobic treatment
  - Very little or no dissolved oxygen
  - Slow treatment
  - Produces methane, hydrogen sulfide gas
- Rely on soil to do the treatment

Why Use ATU's or Media Filters?

- Aerobic environment
  - Aerobic microbes break down waste
    - Faster than anaerobic treatment
- Environmentally sensitive areas
- Soils that are not acceptable for septic tank effluent
  - Hydraulically slow
  - Inadequate vertical separation

Why Use ATU's or Media Filters?

- Systems with large flows or small lots
  - To mitigate impact of subsurface dispersal
  - Allow a higher application rate to soils
- As a means of meeting secondary treatment levels or TN reduction

Effluent Quality Before and After

Constituent	Septic tank	Treatment
BOD (mg/L)	140-220	5-50
TSS (mg/L)	50-100	5-50
TKN	40-100	5-25
Total P (mg/L)	5-15	4-10
Fecal col/100ml	1 million to 100 million	1,000 – 100,000

Influent Quality to Devices

- Almost always requires primary settling/treatment
  - Minimize non-degradable solids entering ATU
- Systems are more sensitive than septic tanks
- Loss of microbes will disrupt performance
  - Strong sanitizers can be harmful (Quats)
  - Medications (antibiotics, chemotherapy drugs) can kill-off bugs

Environmental Effects

- pH
  - Microbes will adapt consistent pH
  - Sudden change in pH will likely cause a population loss or shift
  - Temperature
    - Units will operate at soil temperature
    - Cool temperatures - slow degradation
    - Warm temperature - faster degradation

Hydraulic and Organic Loading

- Two main design parameters
  - Hydraulic Loading
    - Rate that water will pass through the device
    - Must provide sufficient retention/treatment time
    - Operating consistently at peak flows will cause treatment issues
  - Organic Loading
    - Organic matter is food for microbes
    - More food than microbes – poor quality effluent
    - More microbes than food – high quality effluent

What About N & P?

- Some can be used for N removal or were specifically designed for N removal
  - Single pass converts ammonium to nitrate
  - Recycle for Nitrate removal
- Not used for phosphorus removal
  - P will be released from organic form
  - Some P is removed in biomass
- Additional unit processes must be added for P removal or to improve N removal

Require Maintenance

- Biomass removal from treatment areas
  - May be needed every 6 to 9 months or longer, depending on organic load, the sludge storage area size or amount of media, and the type of treatment system
  - ATU's require some "seed" to be left in them
  - Keep media wet in attached growth systems
  - Clean or rake media in filters

Require Maintenance

- Aeration system maintenance
  - Blowers and motors need serviced
- Service contract
- Long-term costs
  - Energy
  - Inspection
  - Maintenance

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Aerobic Treatment Units

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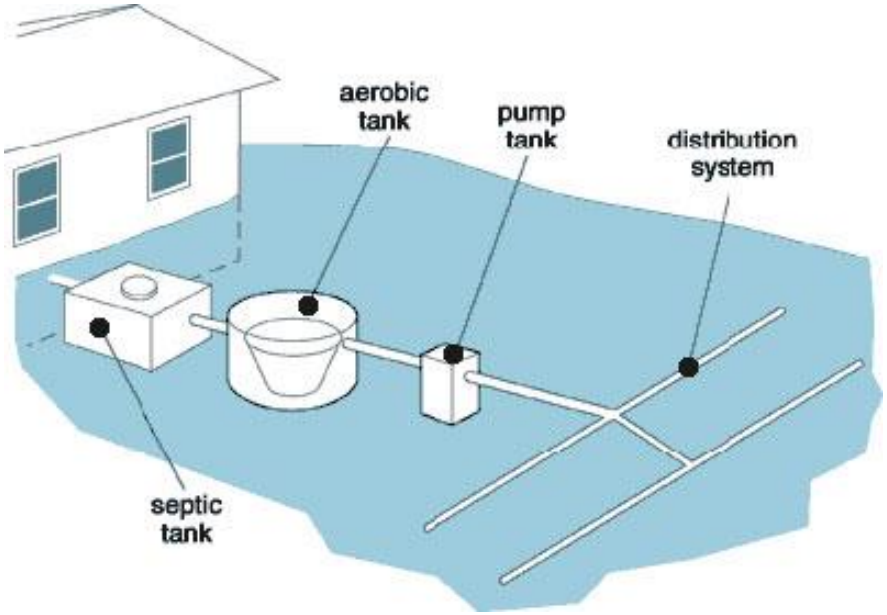
ATU -Description

- Consists of a water tight structure with air being introduced mechanically to facilitate treatment.
- Wastewater goes through a settling area and usually enters the aeration area by gravity.
- The aeration area is a liquid (saturated) environment with Dissolved Oxygen levels >2 mg/L and completely mixed
- Some configurations are good for high strength wastewater

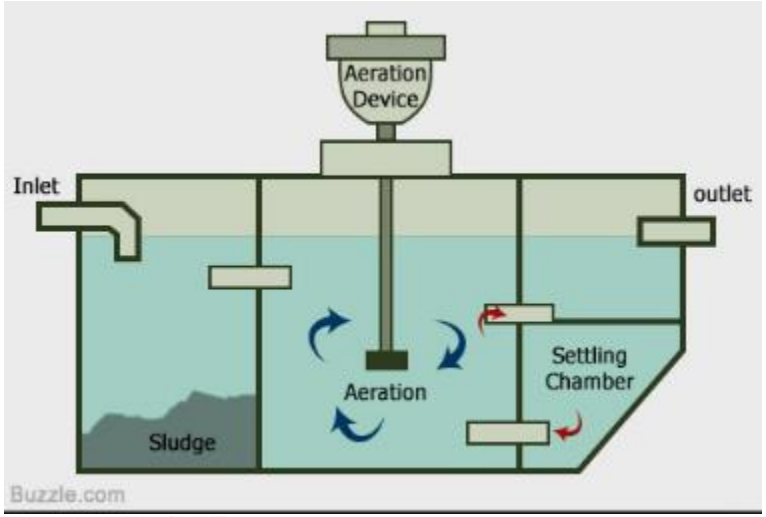
Layout

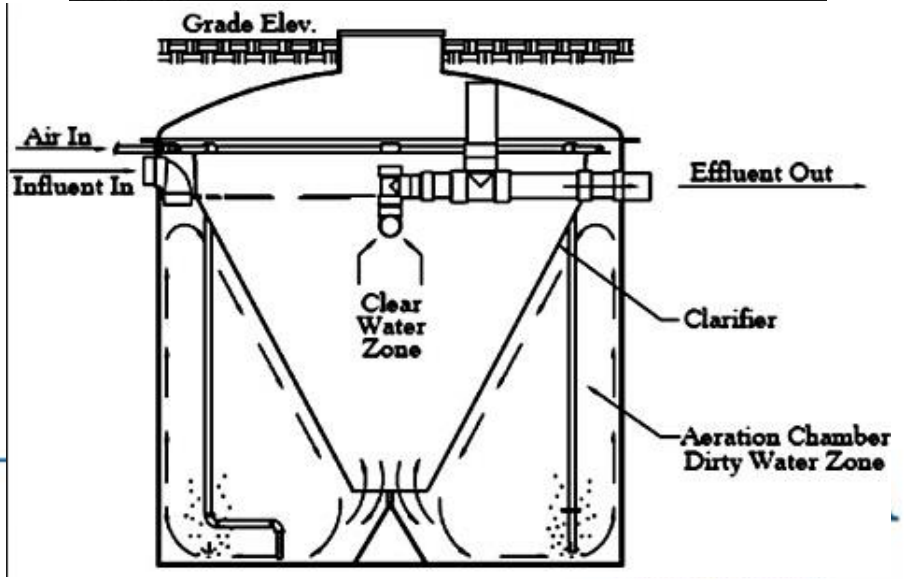
- ATU positioned after septic tank or trash tank
  - Reduces amount of solids entering ATU
  - Provides some flow attenuation



ATUs: Miniature WWTP

- Biological processes are well understood
- Mix microbes, wastewater, and dissolved oxygen
- Some sort of clarification is needed





Aeration and Mixing

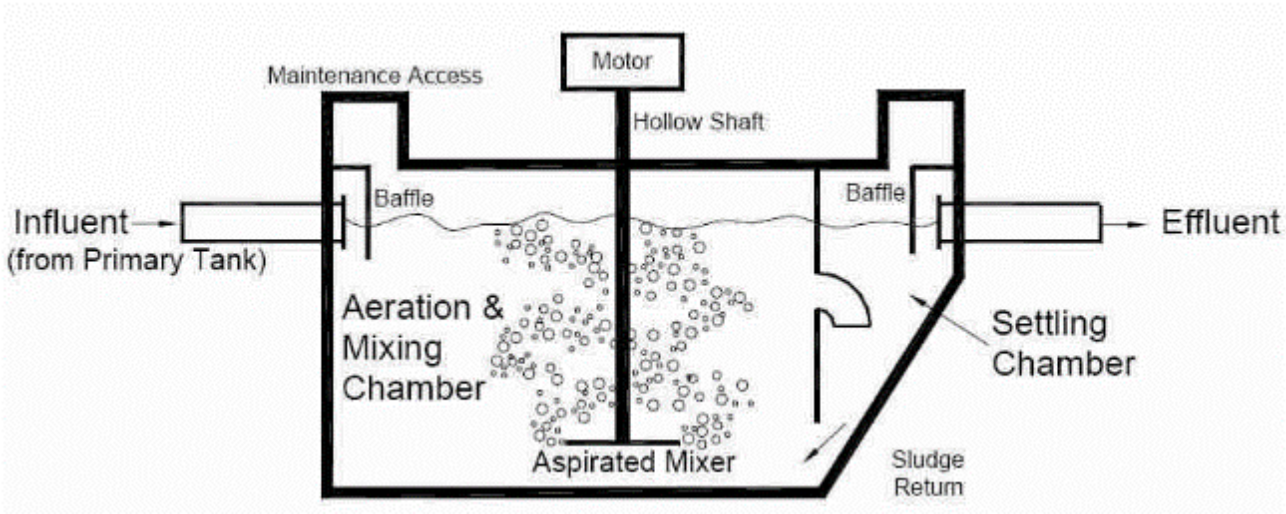
- Aeration system facilitates mixing
  - Displacement of water as air is introduced causes turbulence

ATU Aeration Method

- Diffusion
  - Air is pushed into the system through small orifices in a diffuser of some sort

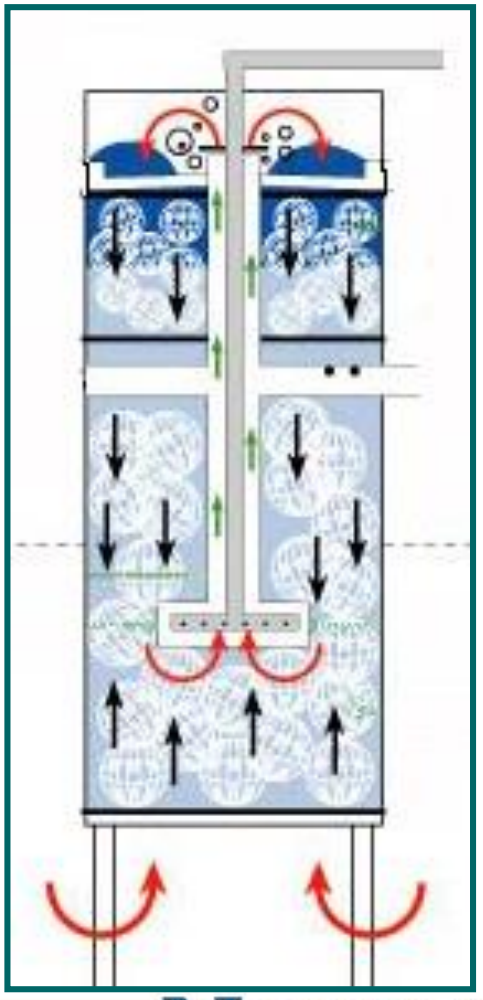
ATU Aeration Method

- Mechanical – aspirator
  - Motor turns the mixer and draws air in and down the shaft



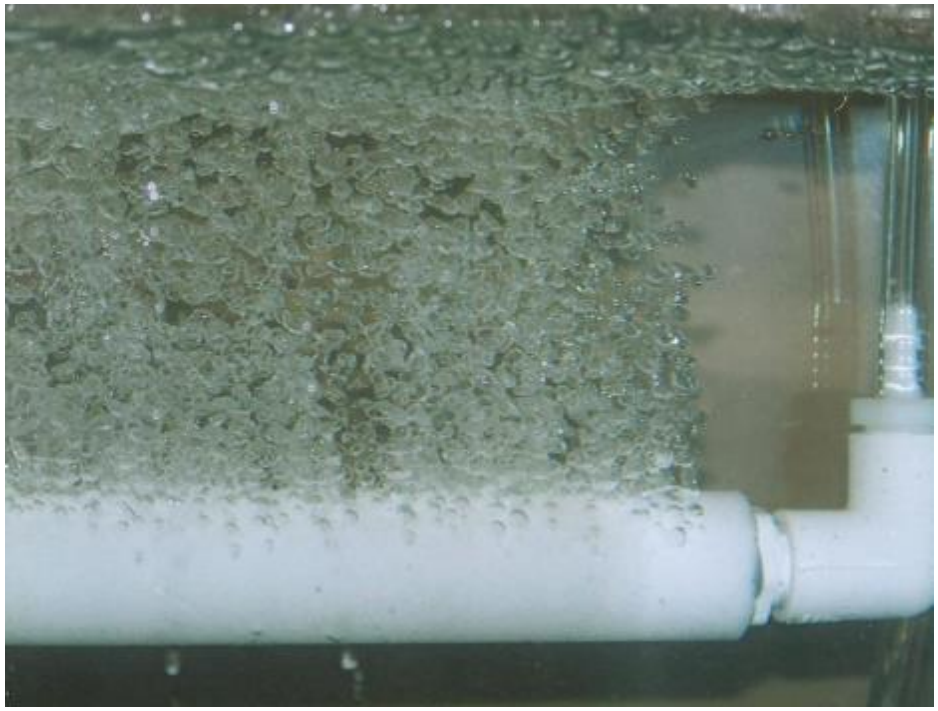
ATU Aeration Method

- Air-lift pump
  - Air is put into a pipe that opens up inside another pipe and draws wastewater up as it aerates it



Oxygen Transfer into Solution

- Fine Bubble vs. Course Bubble Diffusion
  - Oxygen transfer takes place across interface between air and water
  - Fine bubbles have more surface area than course bubbles
  - Depends on the application



Air Supply Operation

- Continuous
- Timed

Venting

- Air entering system
- Air must exit somewhere
  - Unit
  - House vent
  - Biofilter

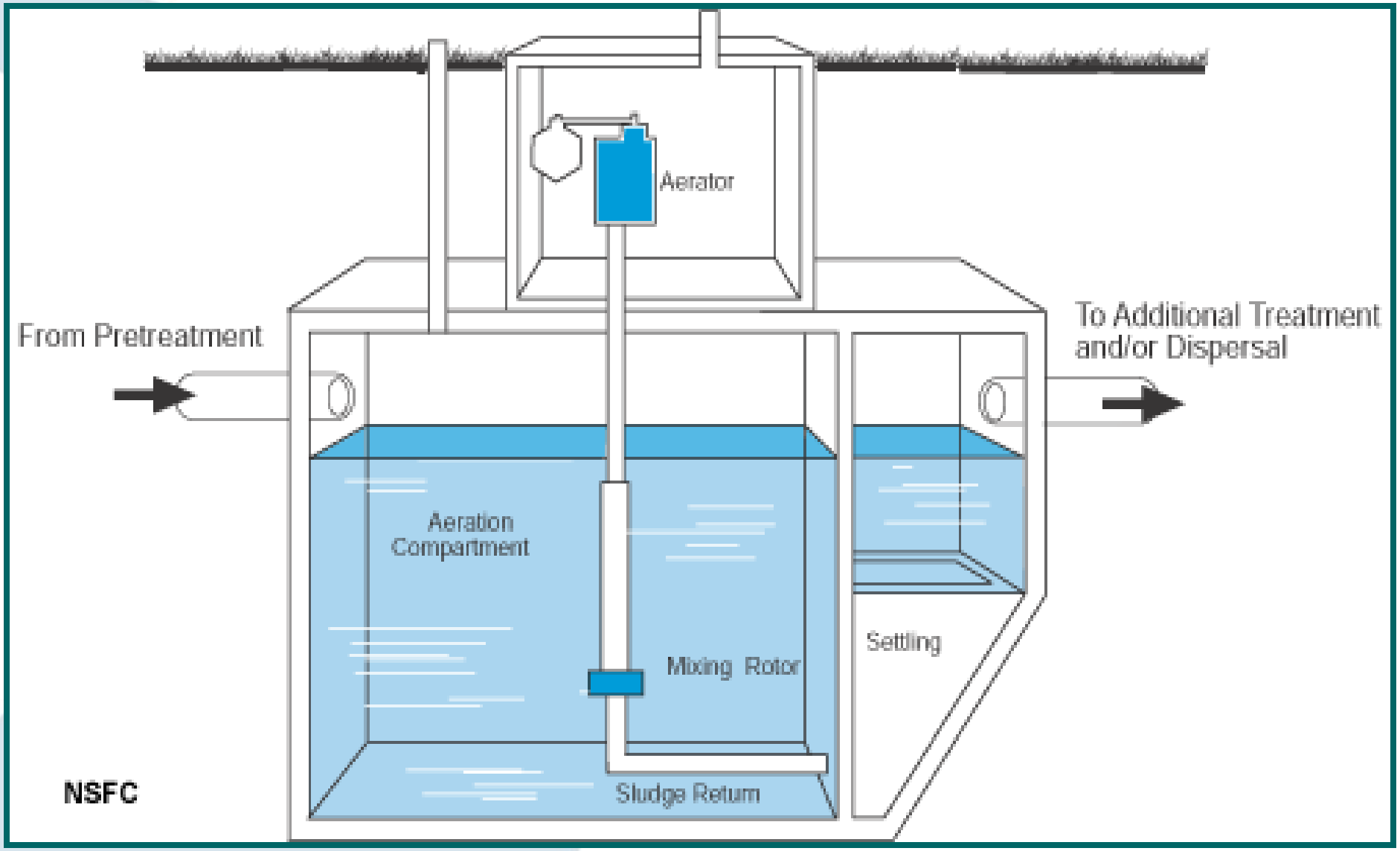
Microorganism Growth Methods

- Suspended growth
  - Microorganisms free float and move in mixed liquor
- Fixed/attached growth
  - Microorganisms are attached to a fixed or moving media

Suspended Growth Reactors

- Activated sludge process
- Biomass is thoroughly mixed with nutrients and biodegradable compounds
- Organisms flocculate and form active mass of microbes - biological floc
- Food mixes with microbes

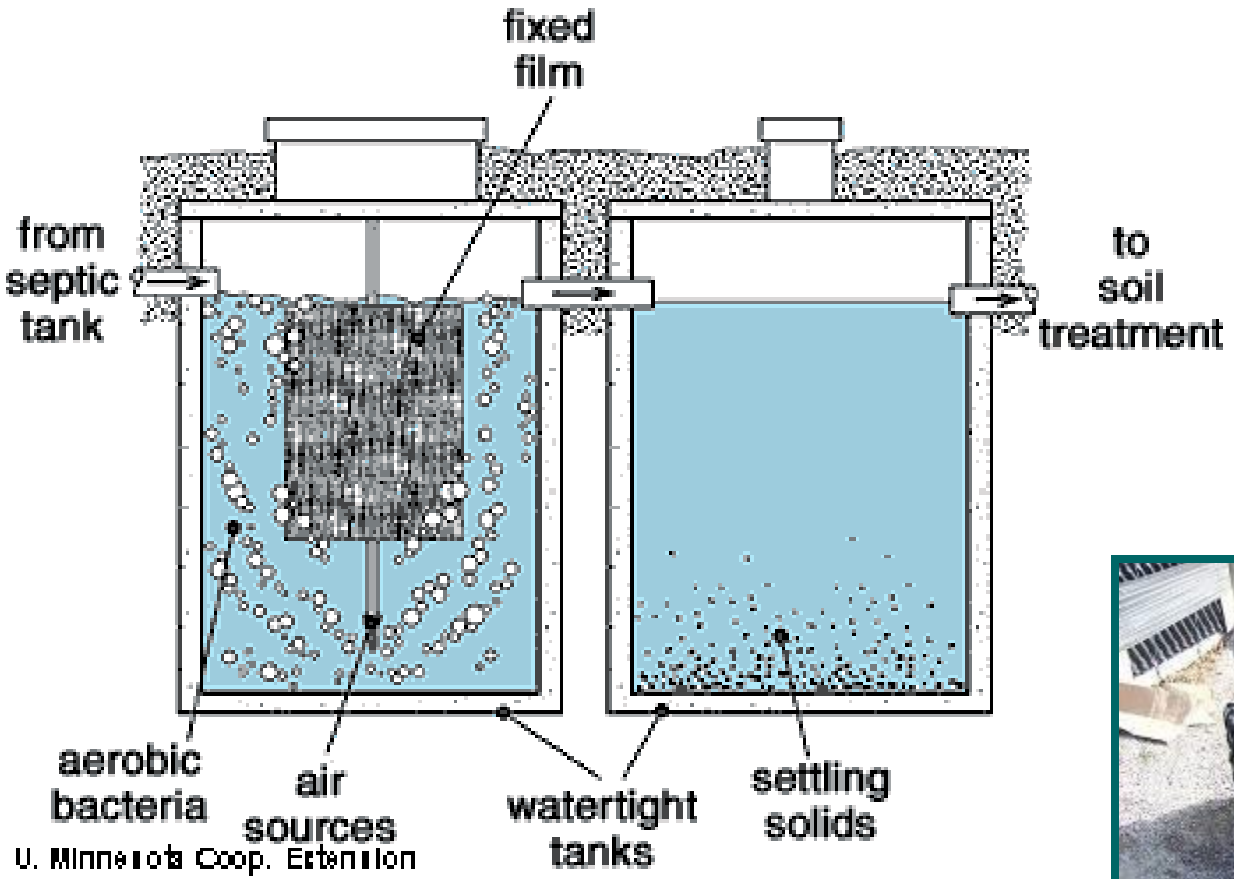
Suspended Growth



Fixed/Attached Growth Reactors

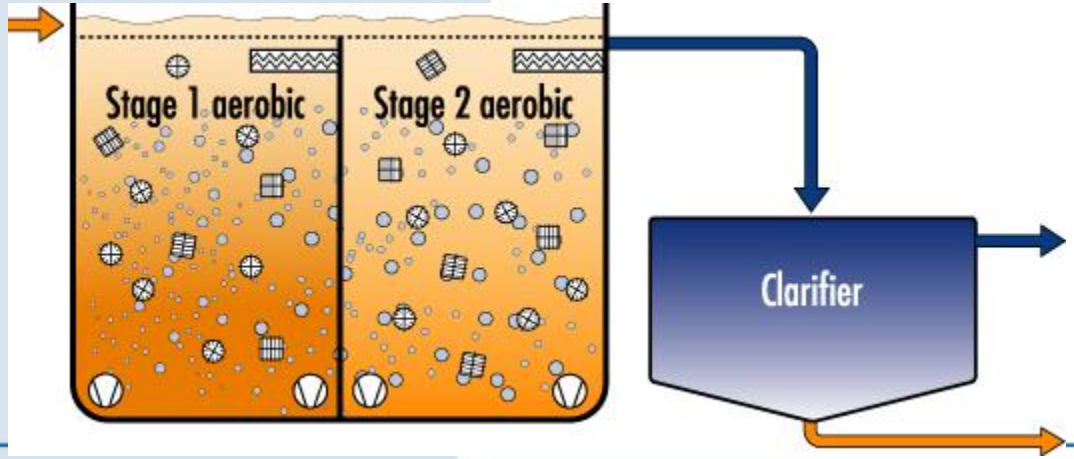
- Fixed-film process
- Inert medium submerged in aeration chamber
- Effluent circulated through media passed the attached microbes
- Organic compounds assimilated by biological film
- Food and oxygen brought to microbes

Fixed/Attached Growth



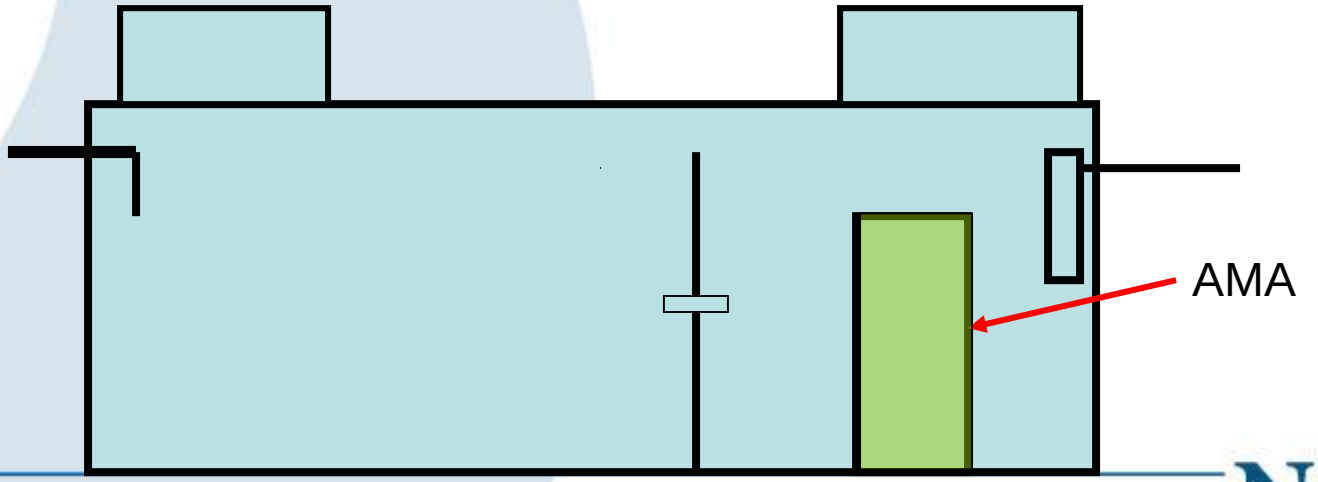
Moving Bed Bioreactors

- Attached growth media are put into the aeration chamber and are moved around in a tank via the aeration method
- Bacteria attach to media



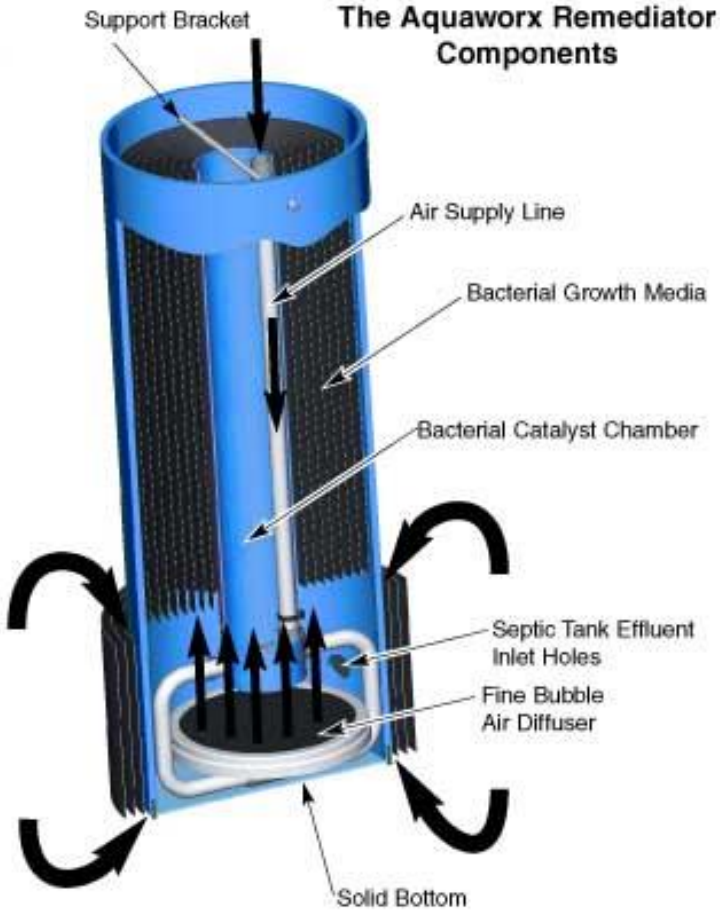
Adaptive Mechanical Aerator

- Add aeration to septic tank
  - Preferably to second compartment
  - Outlet end of a single compartment tank
  - Typically used for remediation

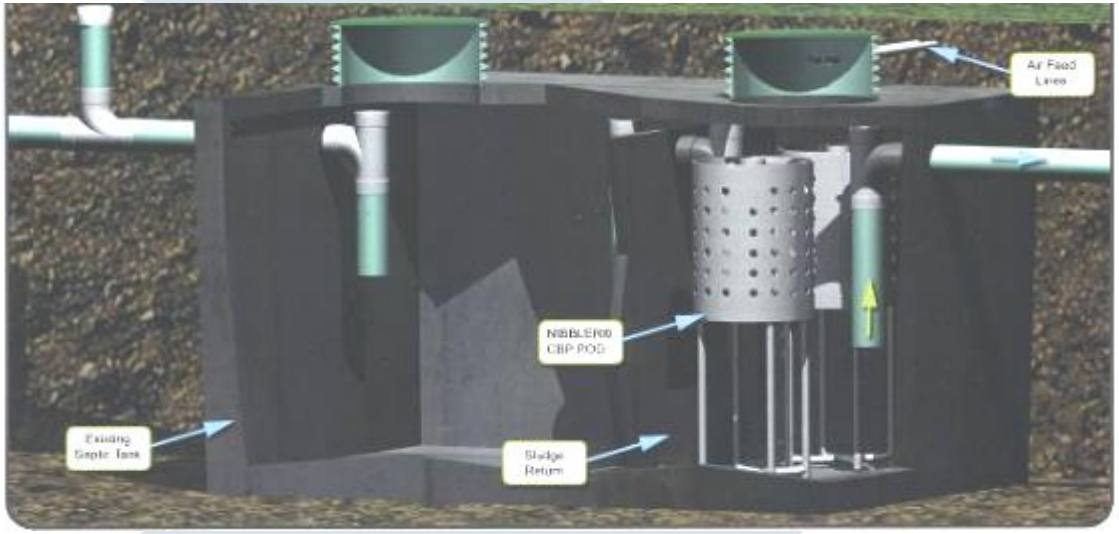


These AMA units add air continuously to septic tank. Periodically add enzyme/bacteria

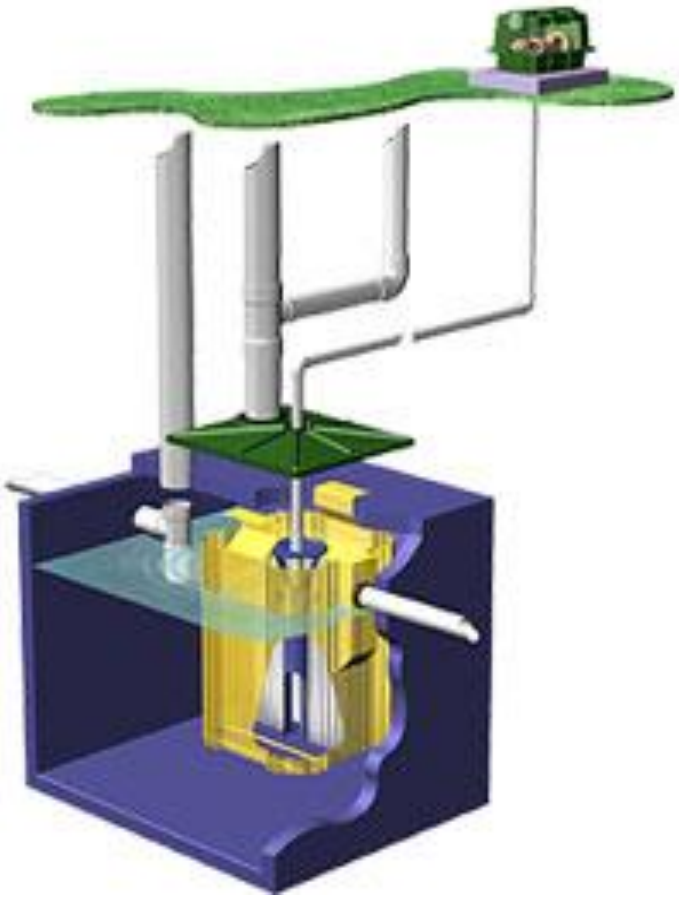
Reduces BOD and TSS of septic tank effluent



These AMA units add air only and no enzyme/bacteria



Nibbler CBP Residential Unit



Bio-Microbics RetroFAST

Flow Equalization

- Equalization tanks (before ATU) can buffer flow = Timed dosing
  - Dose the ATU during low flows
  - Store excess wastewater during high flows
  - Can improve performance

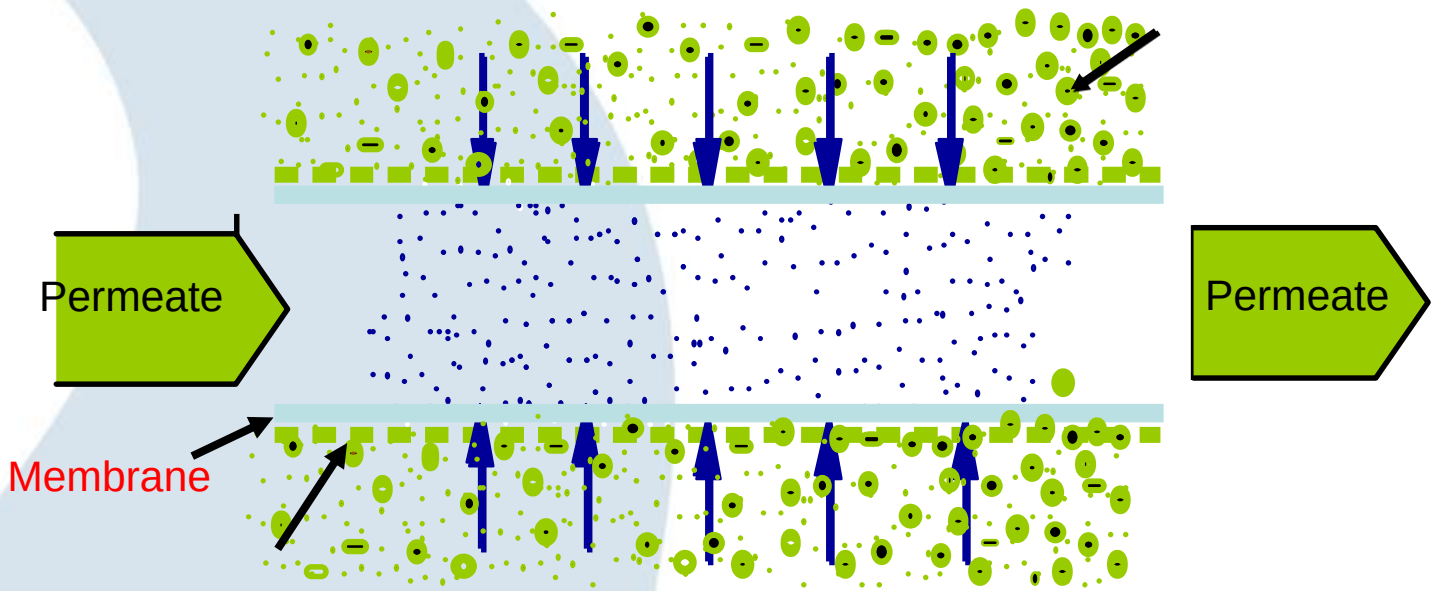
Membrane Bio-Reactors (MBR)

Membranes: What They Are

- Membrane are thin barriers or films of material that allow certain substances to pass
- Membranes that allow only some substrates to pass through them are called semi-permeable membranes
- Useful membranes can be made from polymers, ceramics, metals, or porous materials impregnated with liquid or gelatin-like substances
- Synthetic membranes are usually 100 to 500 microns thick

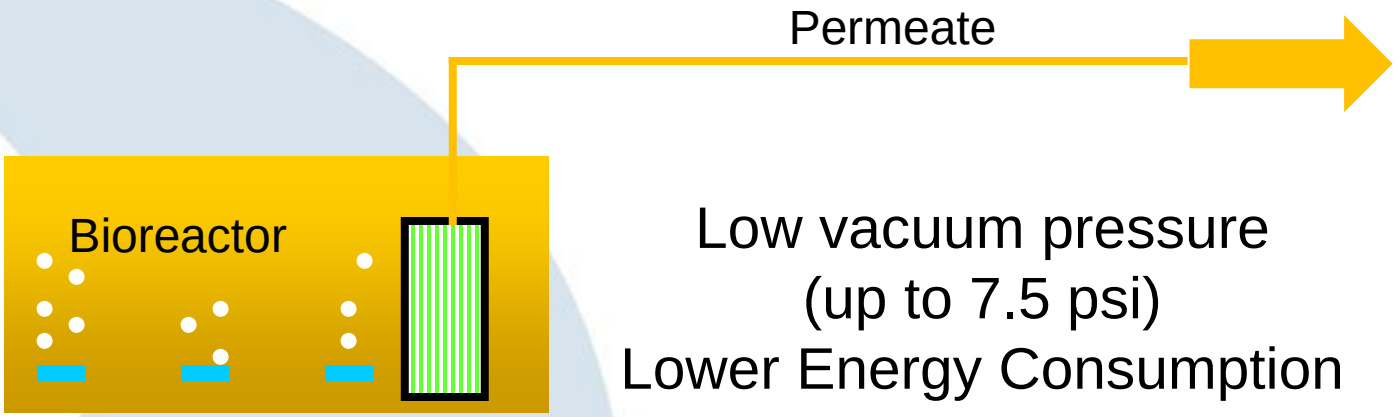
Immersed MBR

Membrane submerged directly in aeration process, outside to inside flow under vacuum



Commercialized 1990's

Immersed Membrane MBR



Low vacuum pressure
(up to 7.5 psi)
Lower Energy Consumption

Reduced the footprint, energy consumption and operational costs

Types of Immersed Membranes

Hollow Fiber

Flat Sheet

Spiral Wound

Membrane Effluent

Flow

Mixed Liquor

Effluent

BOD < 5 mg/l
TSS < 2 mg/l
Turbidity < 0.2 NTU
Fecal <100 cfu

MBR Maintenance

- More involved than other technologies
- Flow and loading also becomes extremely important because you cannot by pass the Membrane material
- Requires periodic cleaning of the membrane surface through back flushing or soaking

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Example of ATU's

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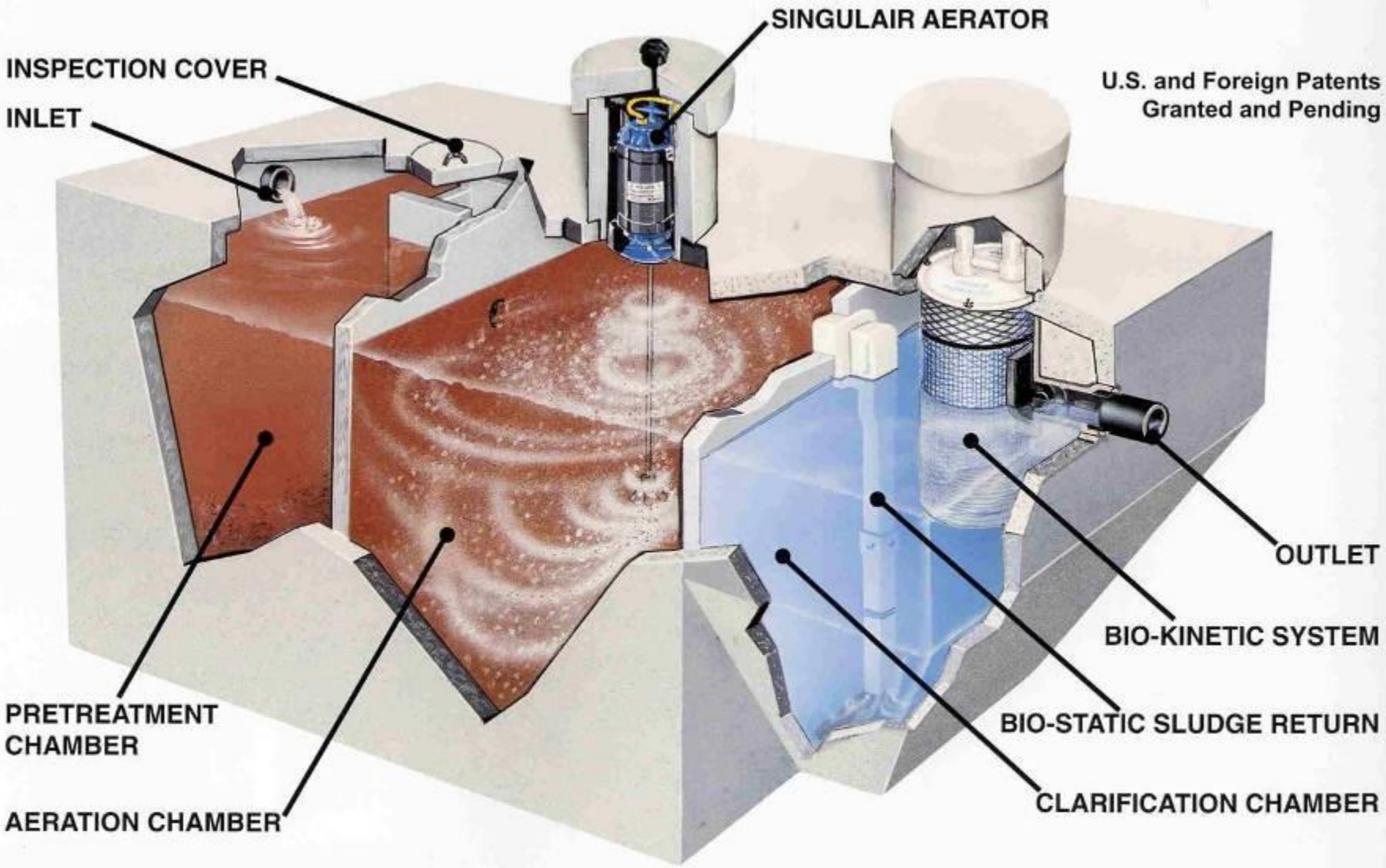
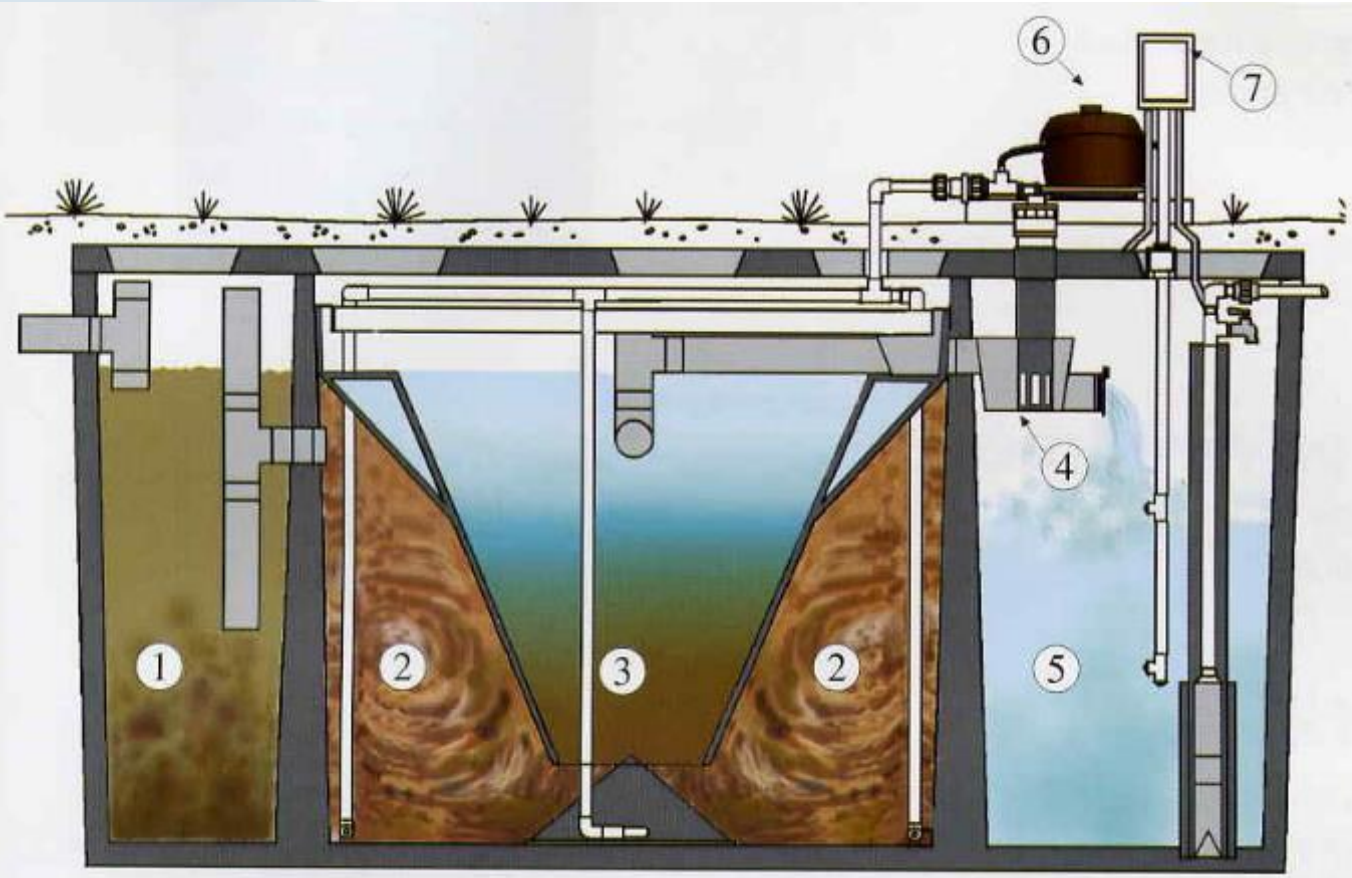
Norweco Singulair System



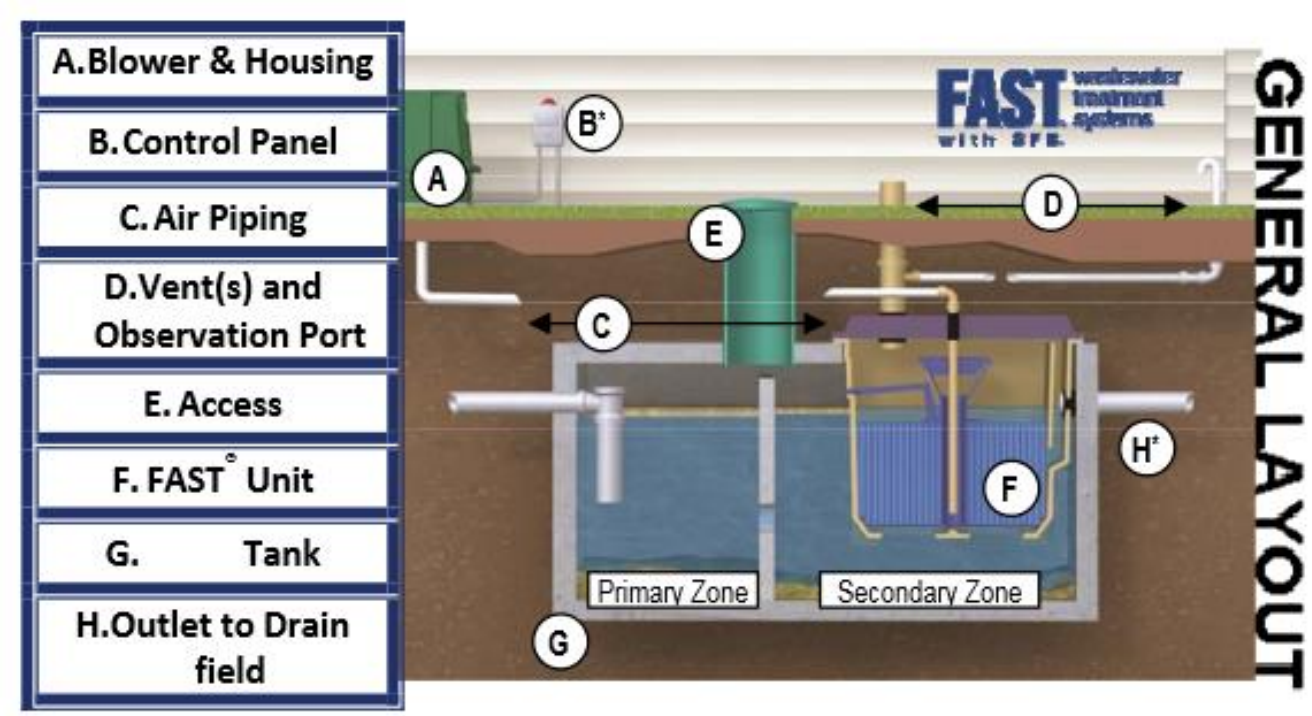
Clearstream System

HOOT

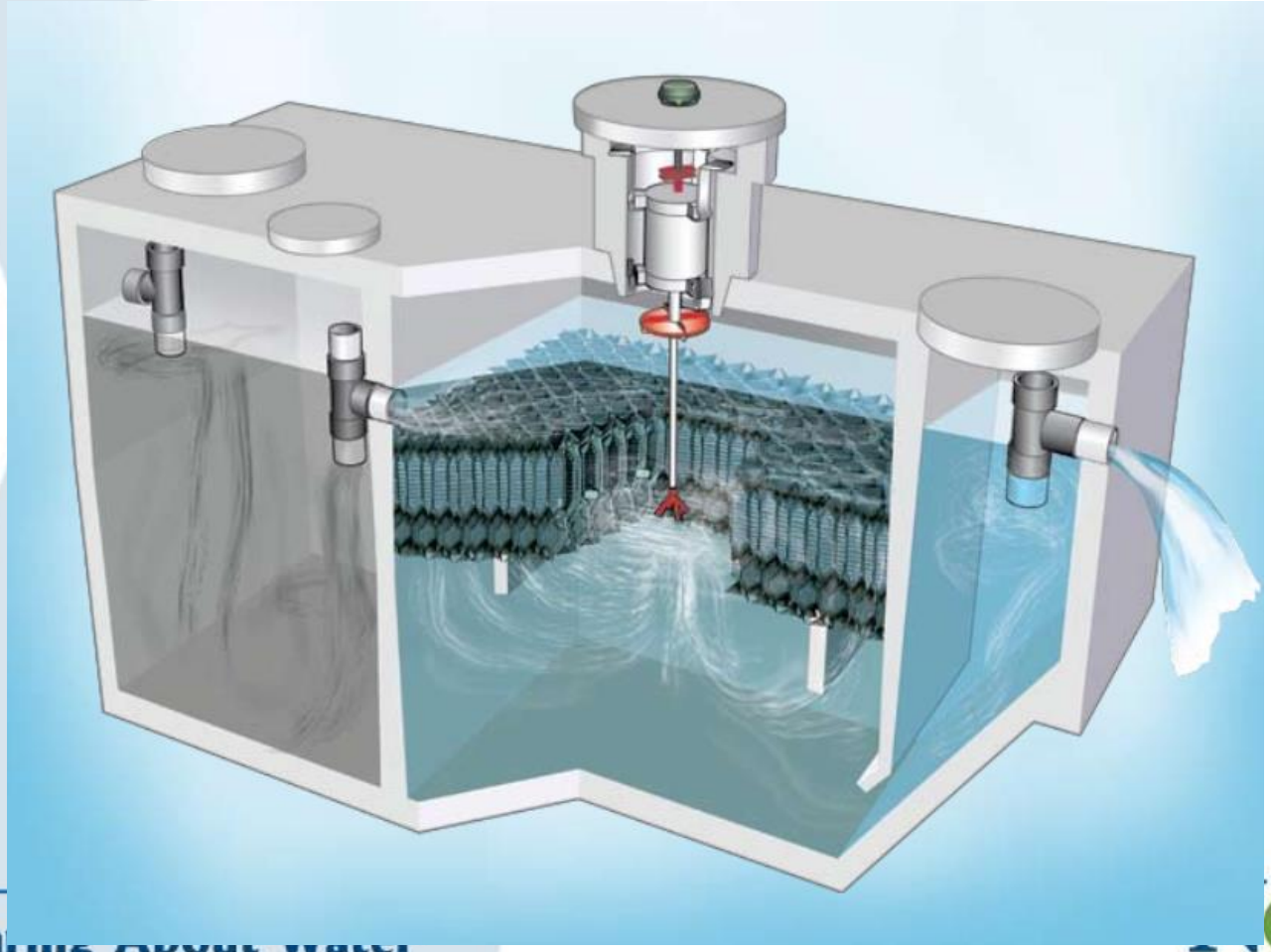


1. *Pretreatment tank where influent enters.*
2. *Aeration chamber where oxygen is pumped into the waste water.*
3. *Clarifier chamber where the clear, odorless effluent rises.*
4. *Chlorinator the clear effluent passes through for disinfection.**
5. *Holding tank for disinfected* effluent ready for discharge.*
6. *Extremely quiet, efficient aerator and pump.*
7. *Unique solid-state HOOT Control Center monitors and controls the system.*

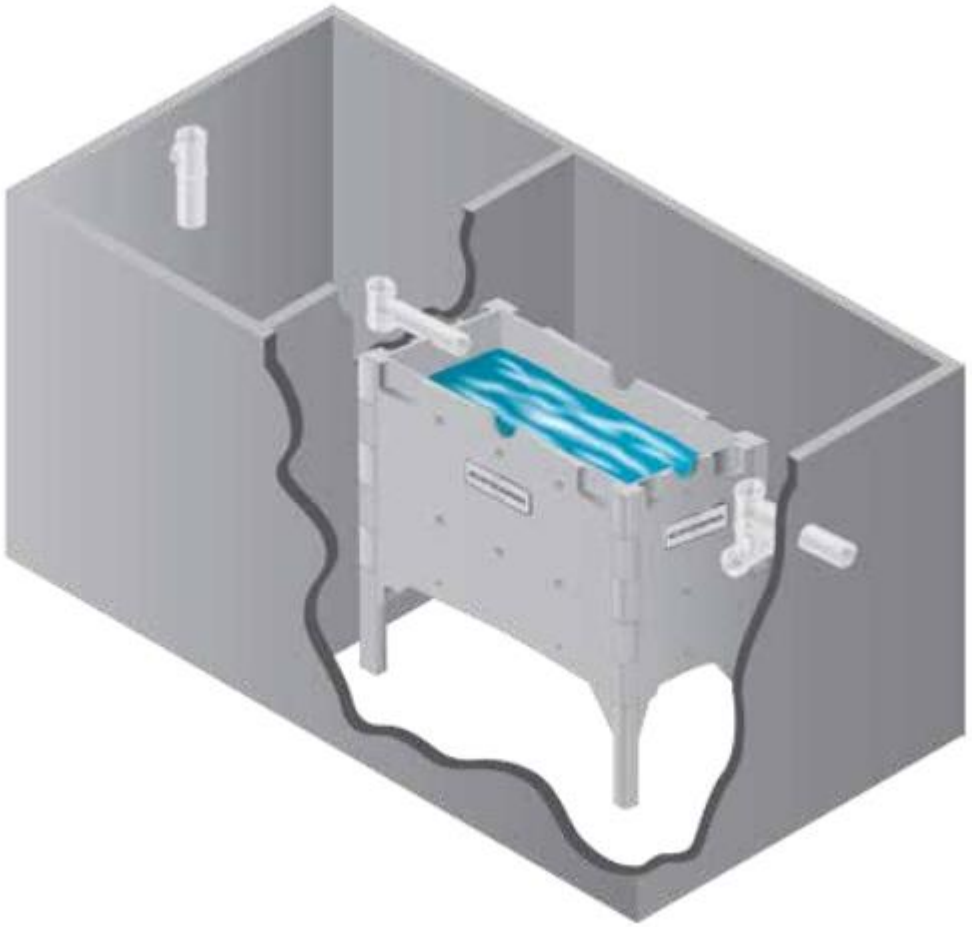
FAST System


A. Blower & Housing
B. Control Panel
C. Air Piping
D. Vent(s) and Observation Port
E. Access
F. FAST® Unit
G. Tank
H. Outlet to Drain field
FAST wastewater treatment systems with SFE
GENERAL LAYOUT
Primary Zone
Secondary Zone

Jet BAT System



Delta Ecopod System



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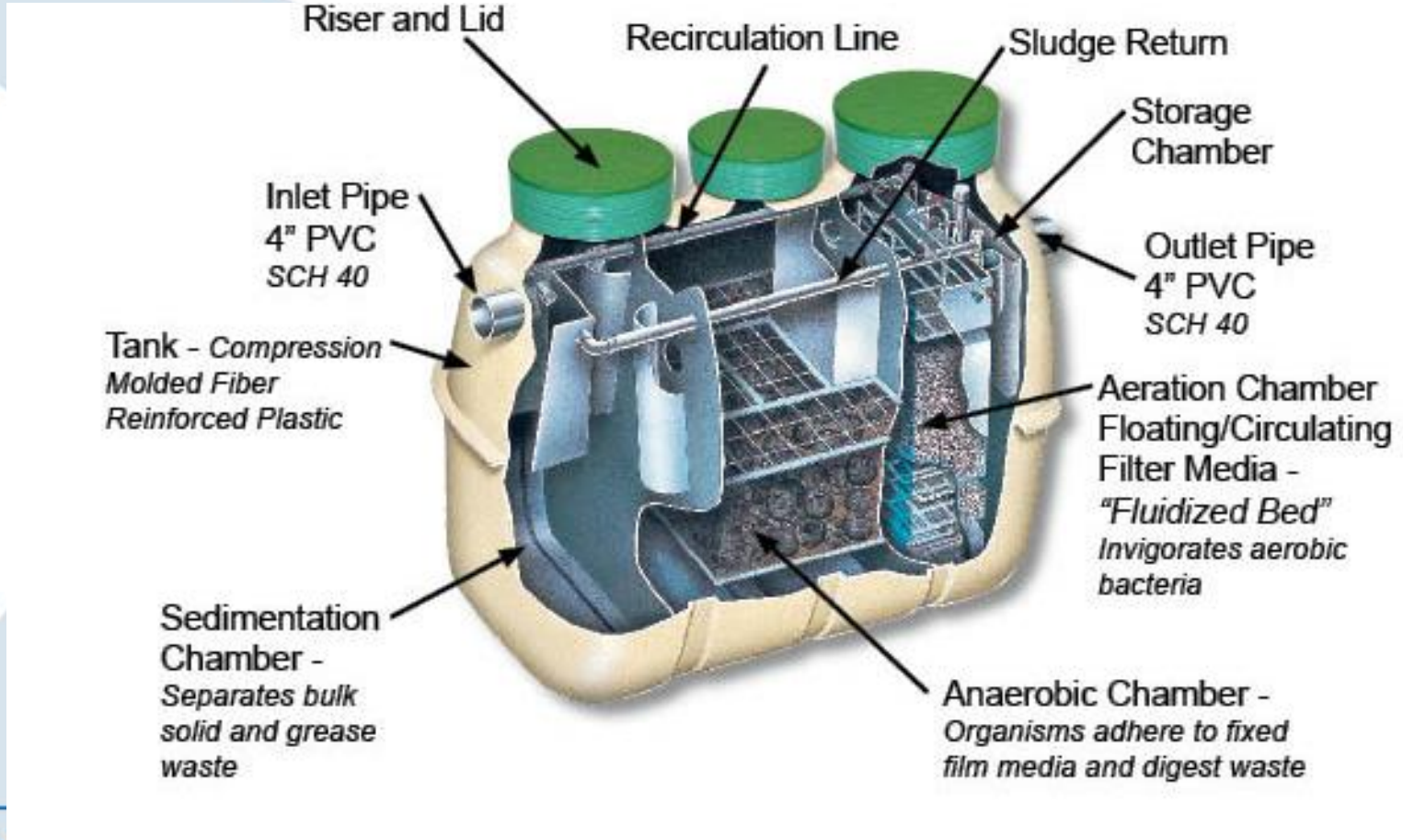
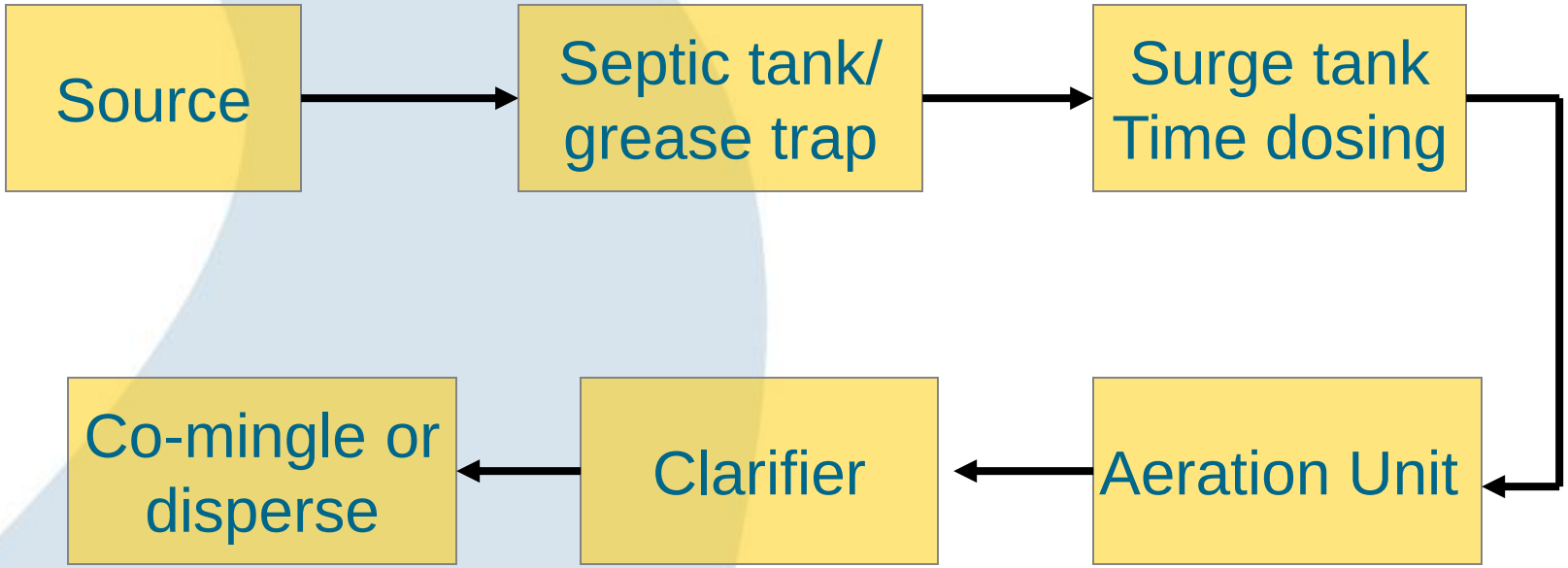
Zoeller Fusion System



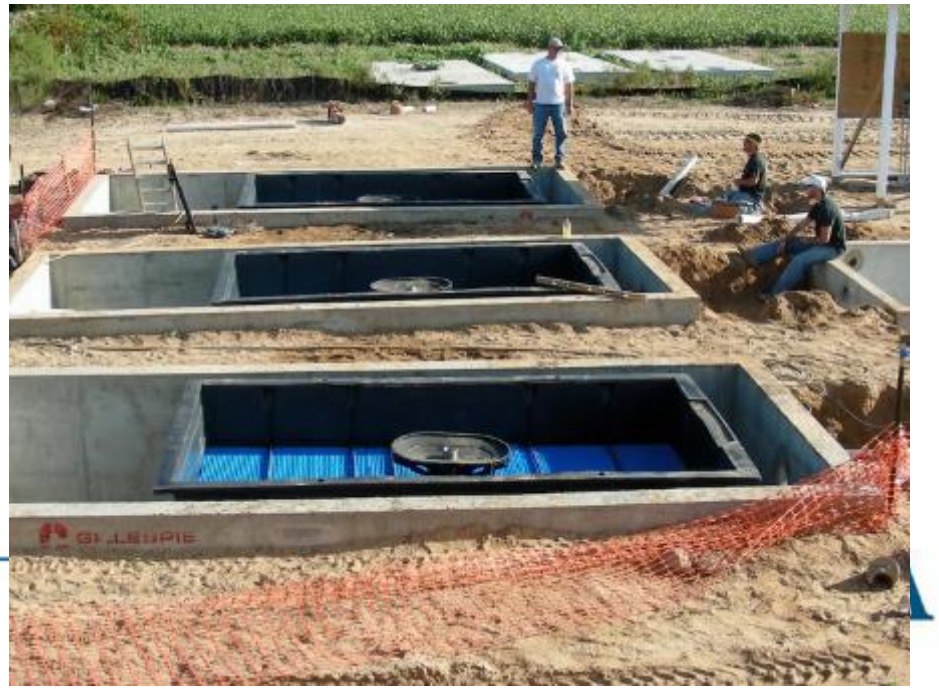
High Strength Wastewater

- Separate high strength wastes from domestic wastewater or
- Treat all the wastewater together



Nibbler - designed to handle high strength wastes

Bio-Microbics HighStrength FAST -designed to handle high strength wastes



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Delta Ecopod C - designed to handle high strength wastes

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Questions

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